



ENVIRONMENTAL RESTORATION PROGRAM

# How Contaminants Move in the Environment



A DSCR Restoration  
Advisory Board (RAB)  
Technical Training Session

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Mitretek Systems

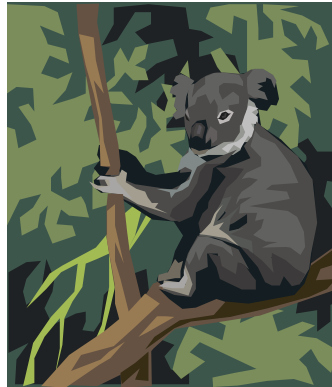
January 9, 2006



# Environmental Media That May Be Contaminated



**Soil**



**Terrestrial  
Organisms**

**Air**



**Surface  
Water**



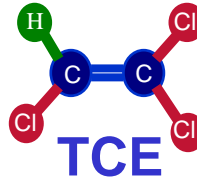
**Groundwater**



# Different Types of Common Contaminants



**Solvents  
(e.g., TCE)**



**Fuels**



**Metals (e.g.,  
Arsenic)**



**Pesticides  
(e.g., DDT)**

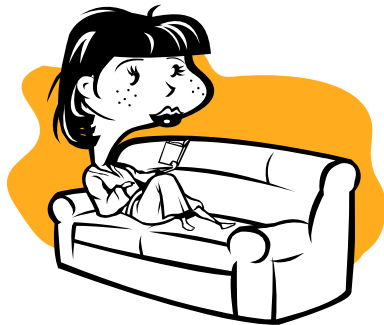


# What Happens After Contaminants are “Out There”?



**Move somewhere else**

**Stay where they are**



**Disappear (change into something else which then either stays put or moves)**





# What Makes Contaminants Move?



- Forces acting on contaminants influence them to move (gradients)



- Potential Gradient = move from higher pressure (elevation) to lower pressure (elevation)
- Concentration Gradient = move from higher to lower concentration

**Nature ALWAYS seeking balance**

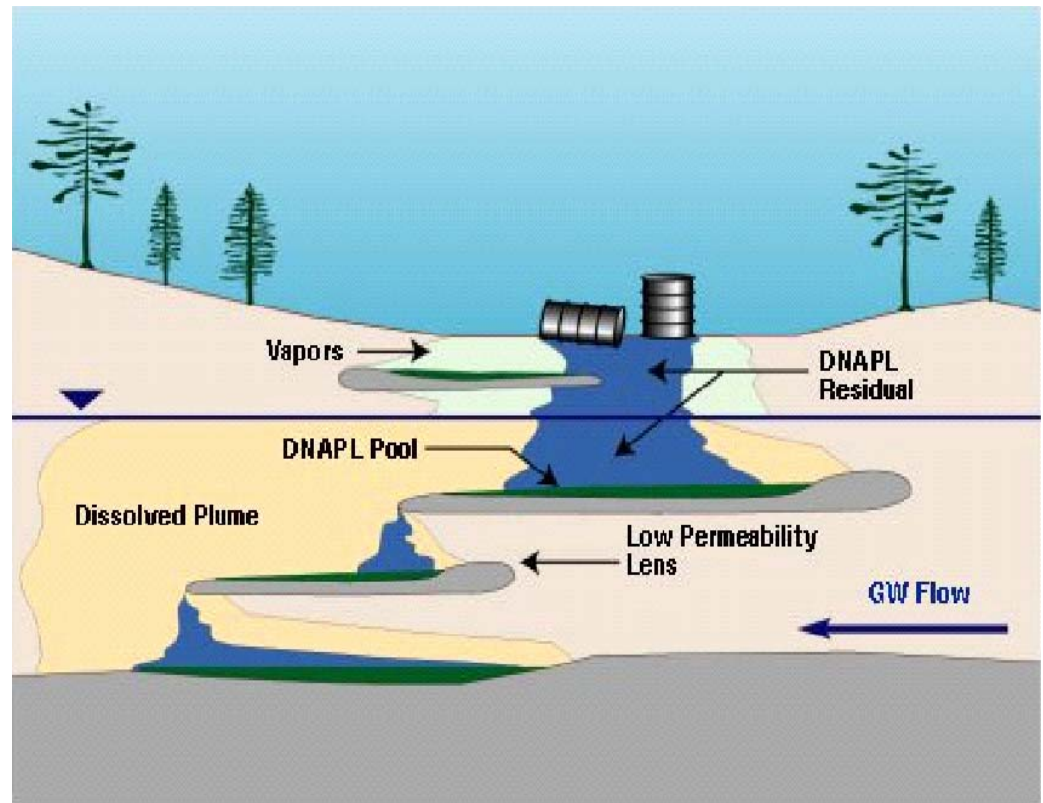




# What Makes Contaminants Stay Where They Are?

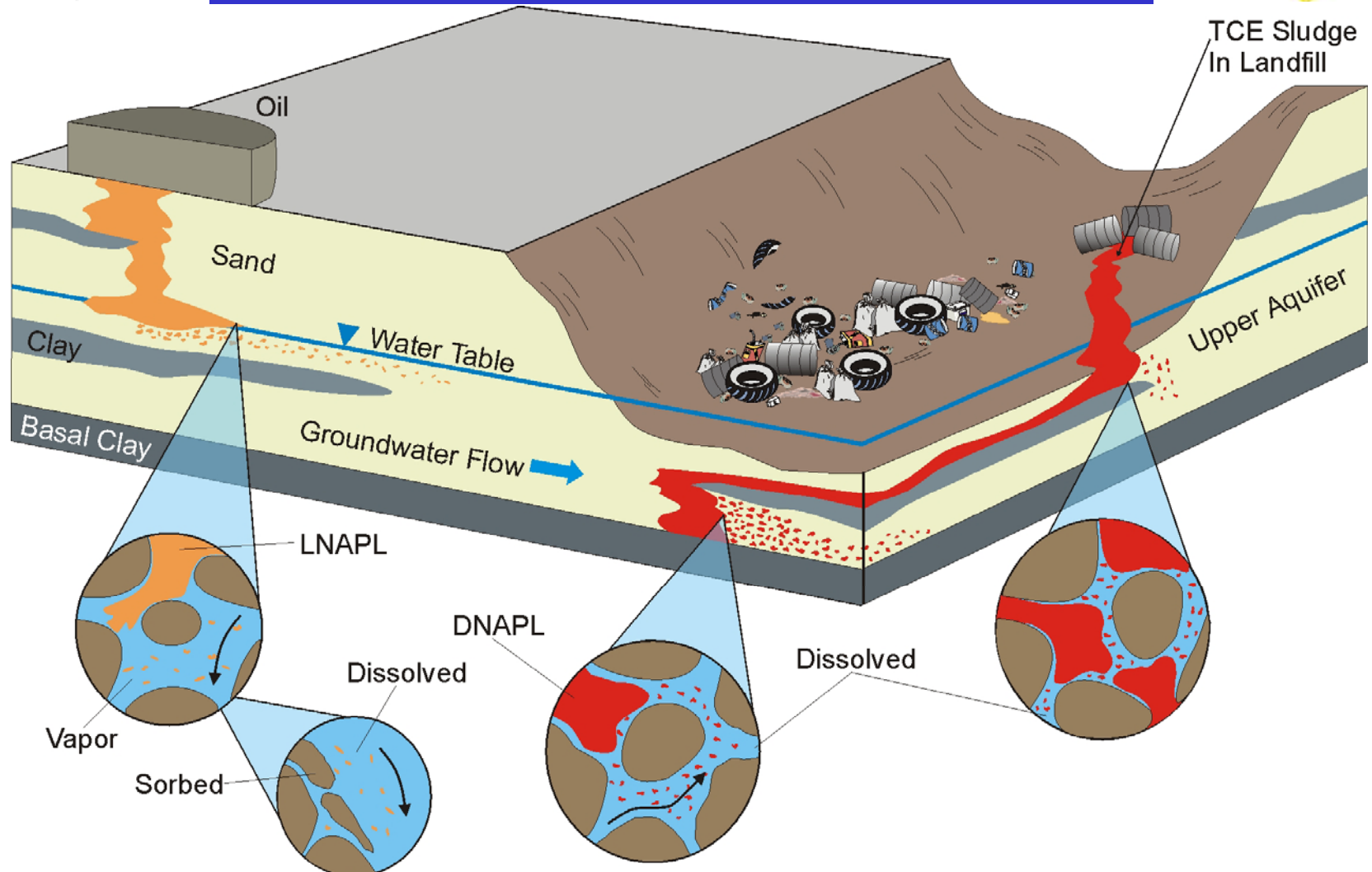


- Forces to move contaminants may not exist –
  - DNAPL sinking into a “bowl-shaped” clay lens
  - Contaminant gets “stuck” to surrounding media (e.g., sorption to soil)
  - Buried drum containing waste oil





# DNAPL and LNAPL in the Subsurface





# DNAPL in the Environment



*Later ...*

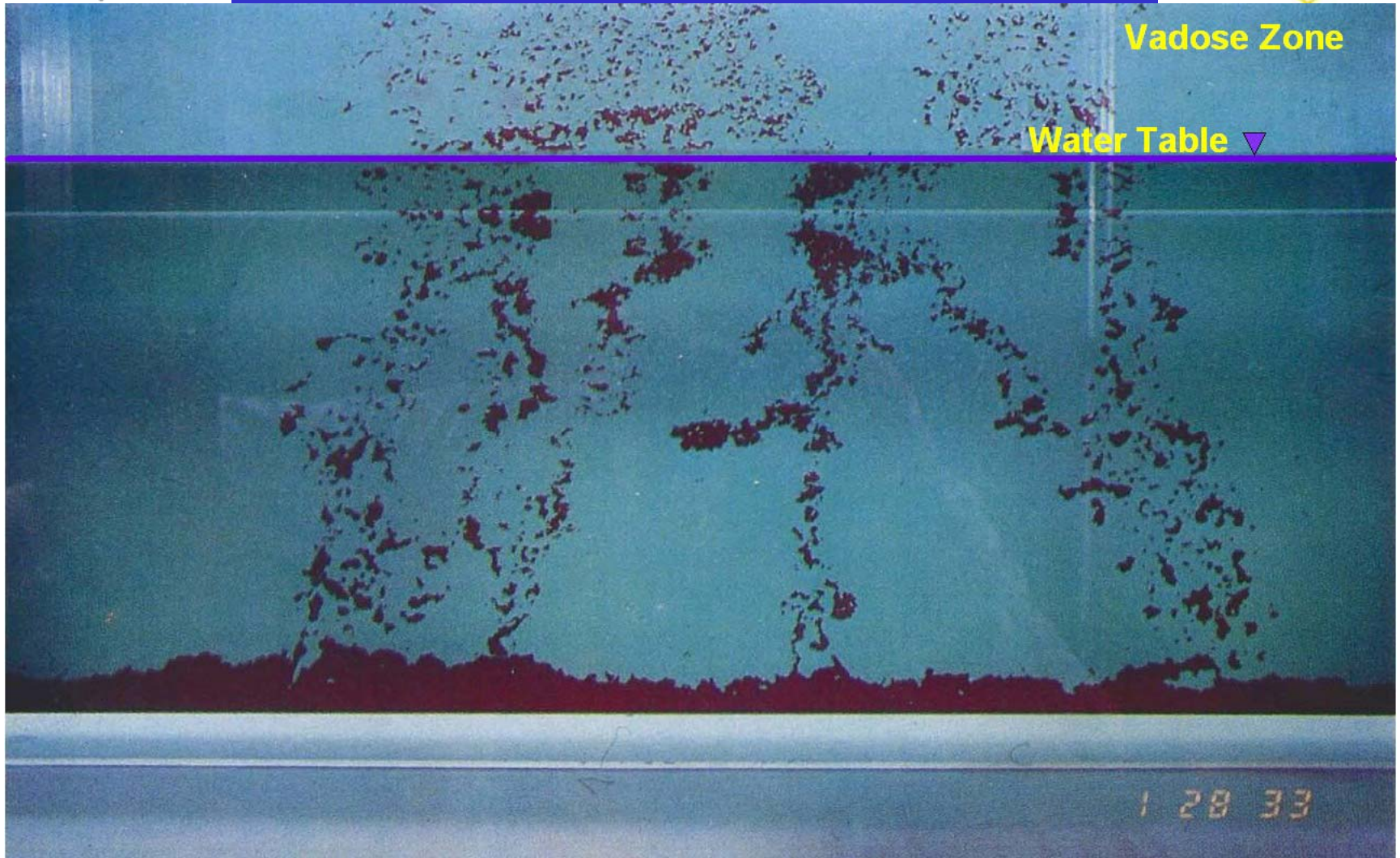


(Schwille, 1988)





# Residual DNAPL in the Subsurface





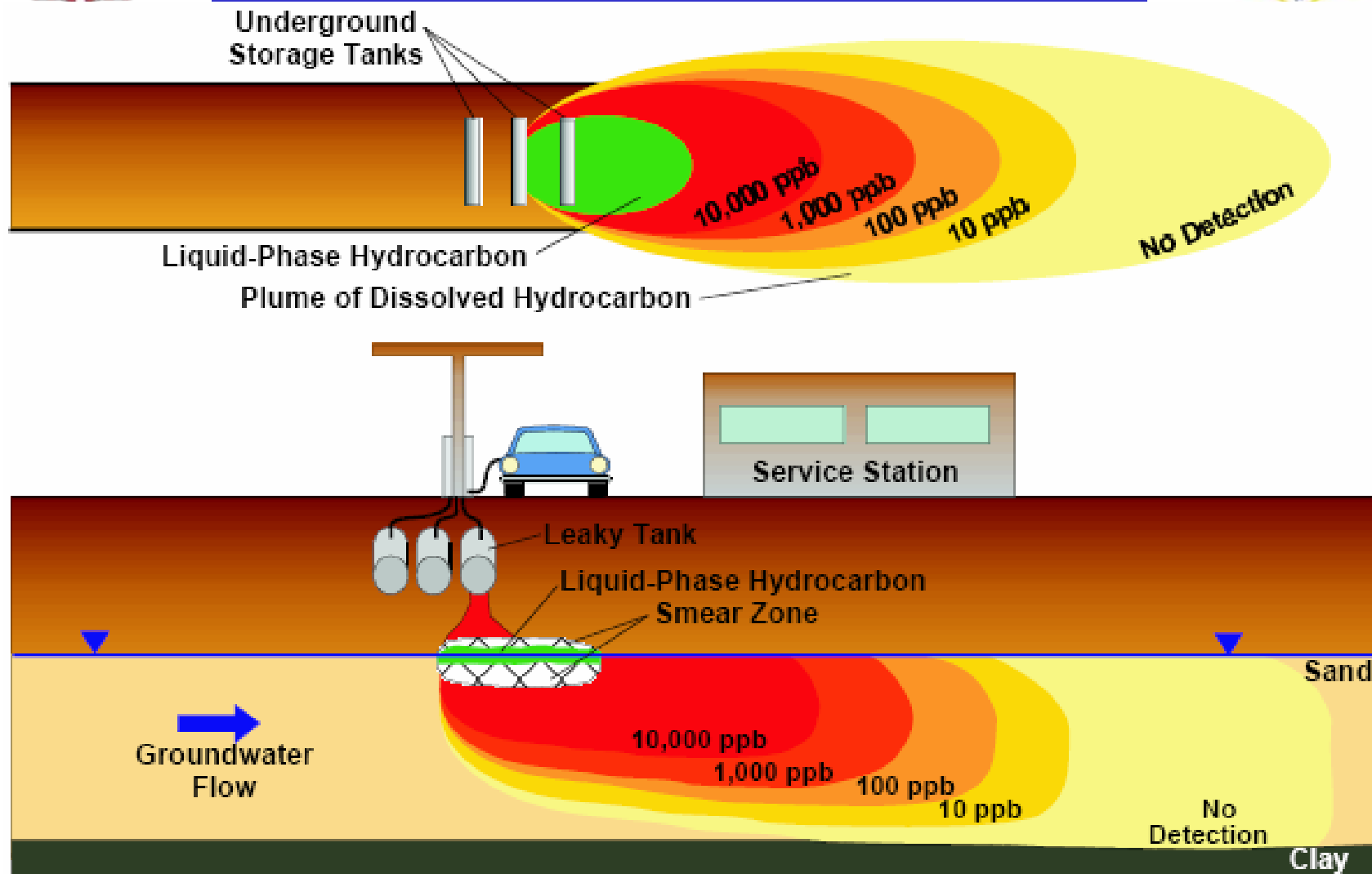
# Contaminant Transport Mechanisms and Concepts



- **Dissolution (NAPL dissolves into water)**
- **Advection (movement caused by pressure or elevation gradient)**
- **Dispersion (“spreading” as contaminant moves through soil)**
- **Diffusion (movement caused by concentration gradient)**
- **Retardation (contaminant slowed during movement)**
- **Volatilization (contaminant changes from solid or liquid to vapor phase)**



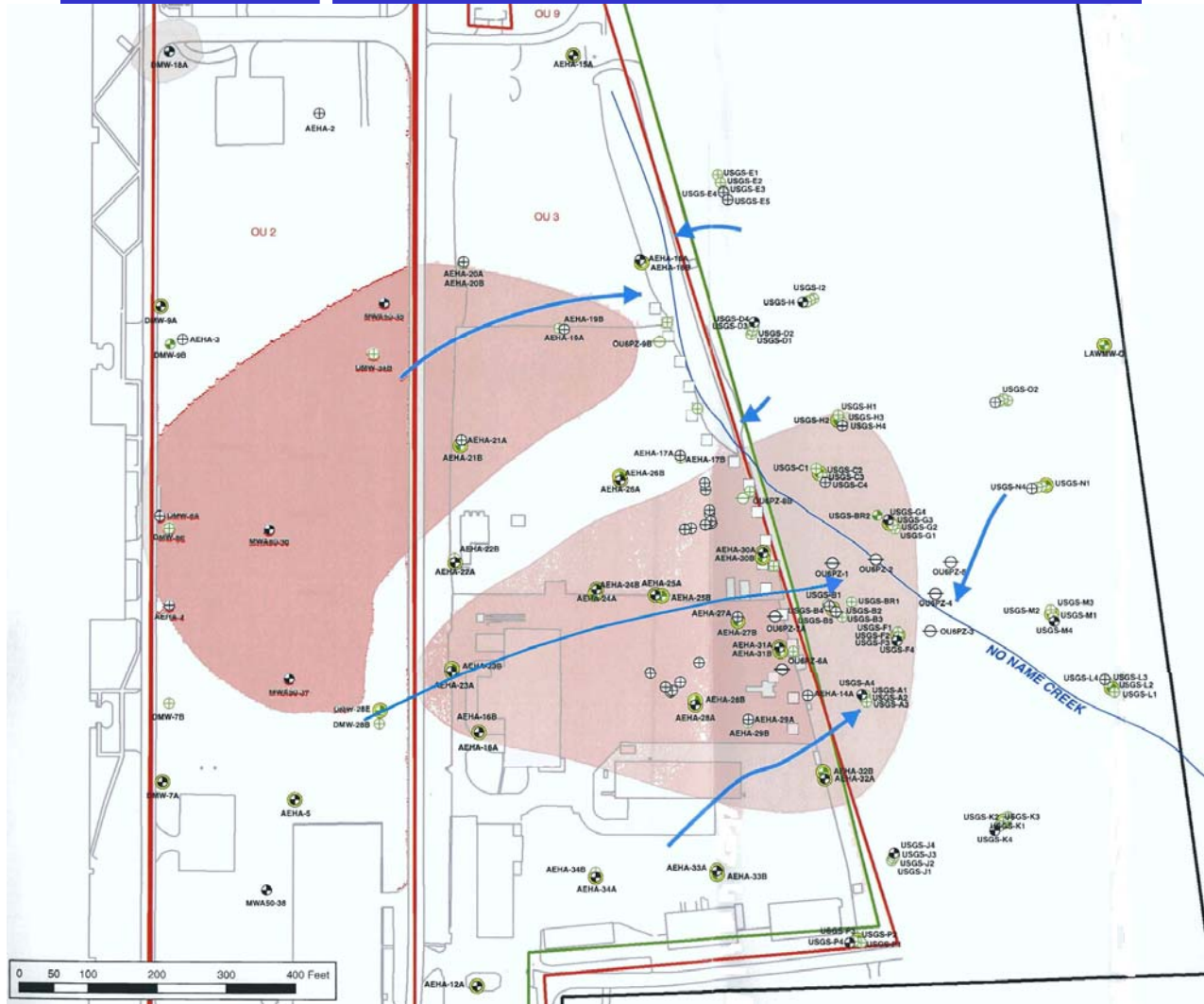
# Dissolution, Advection and Dispersion







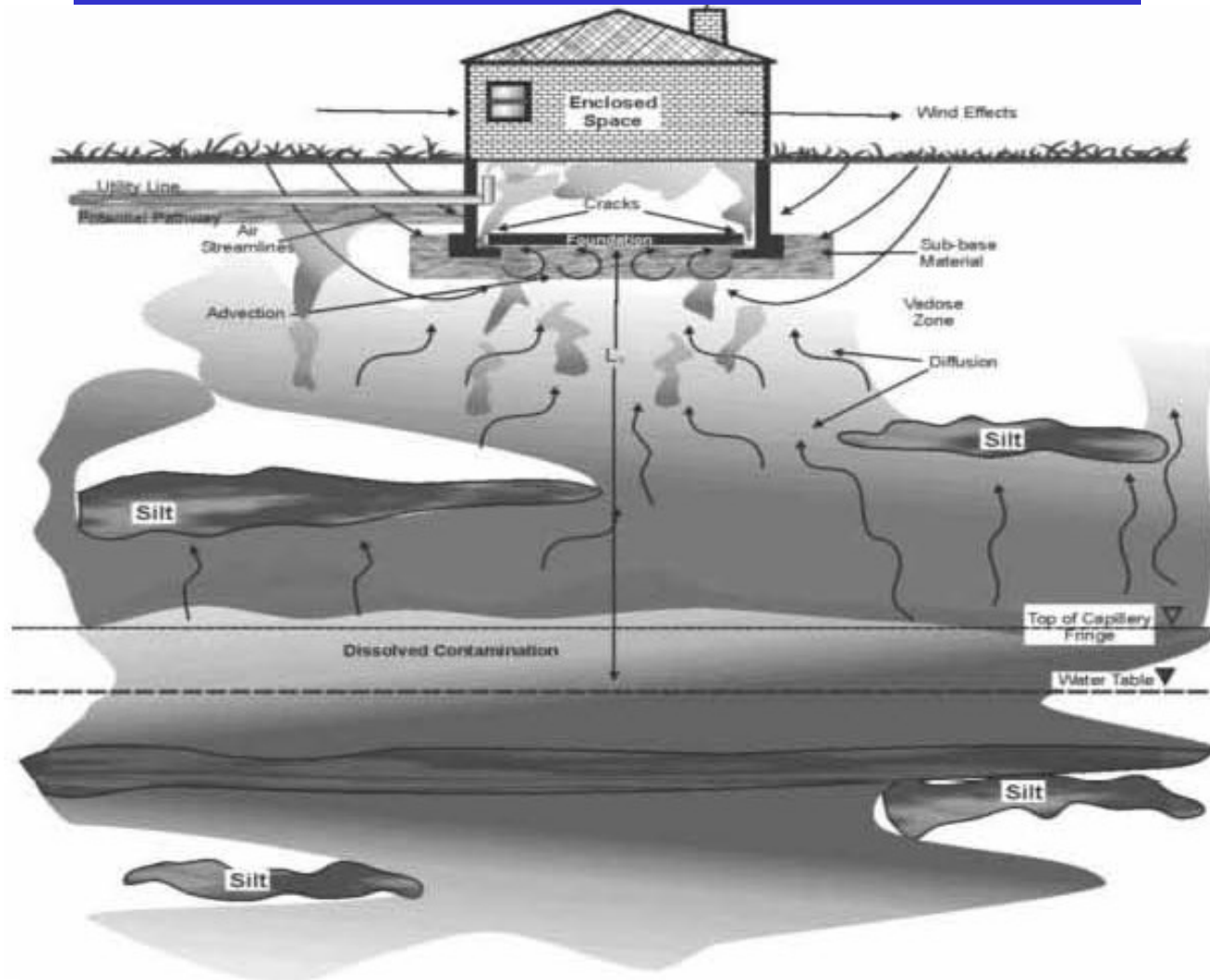
# Dissolved-Phase Advection and Dispersion at DSCR





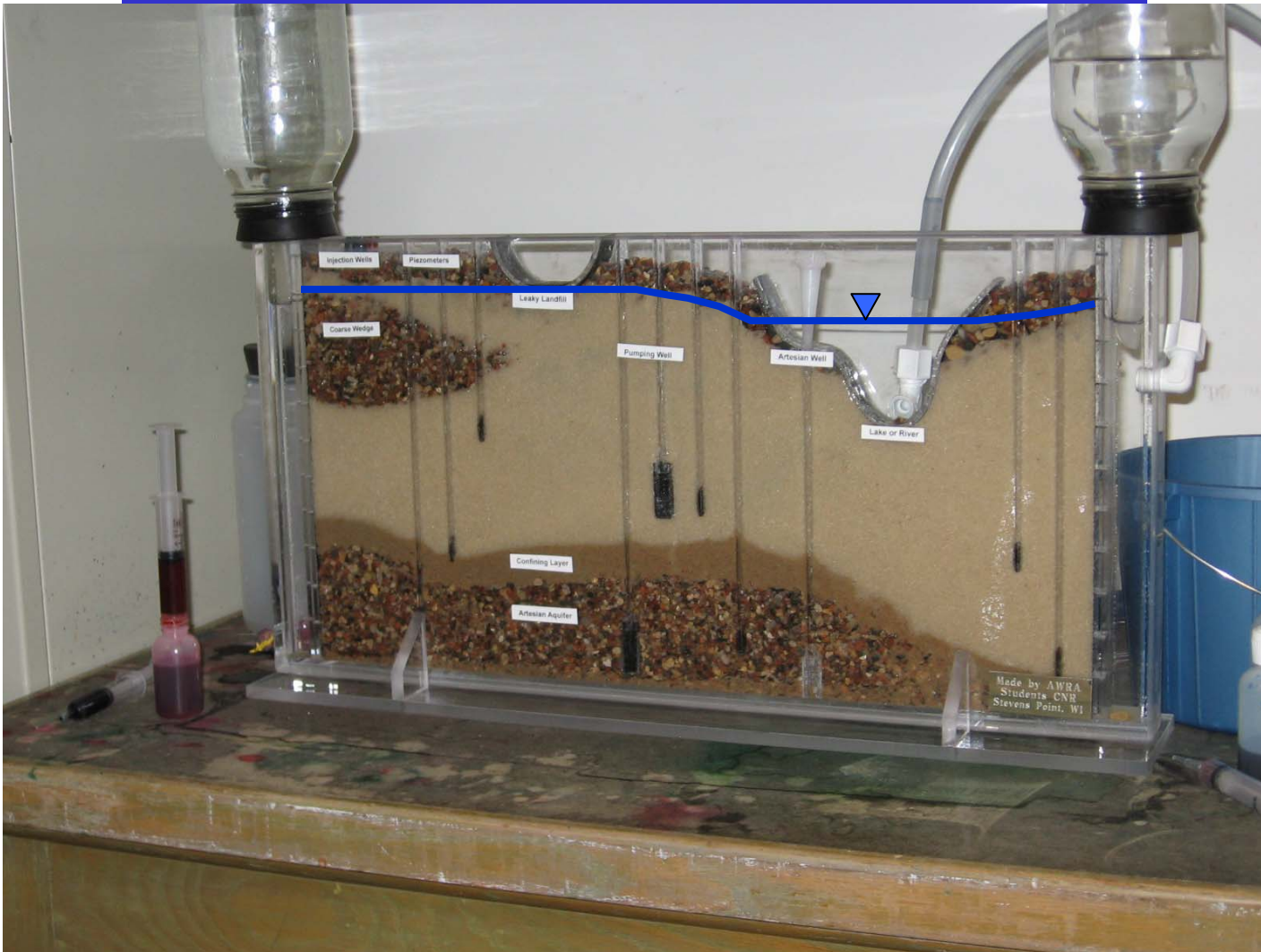


# Volatilization and Movement as Vapor





# Physical Model (“Sand Tank”)





# Physical Model (Cont.)







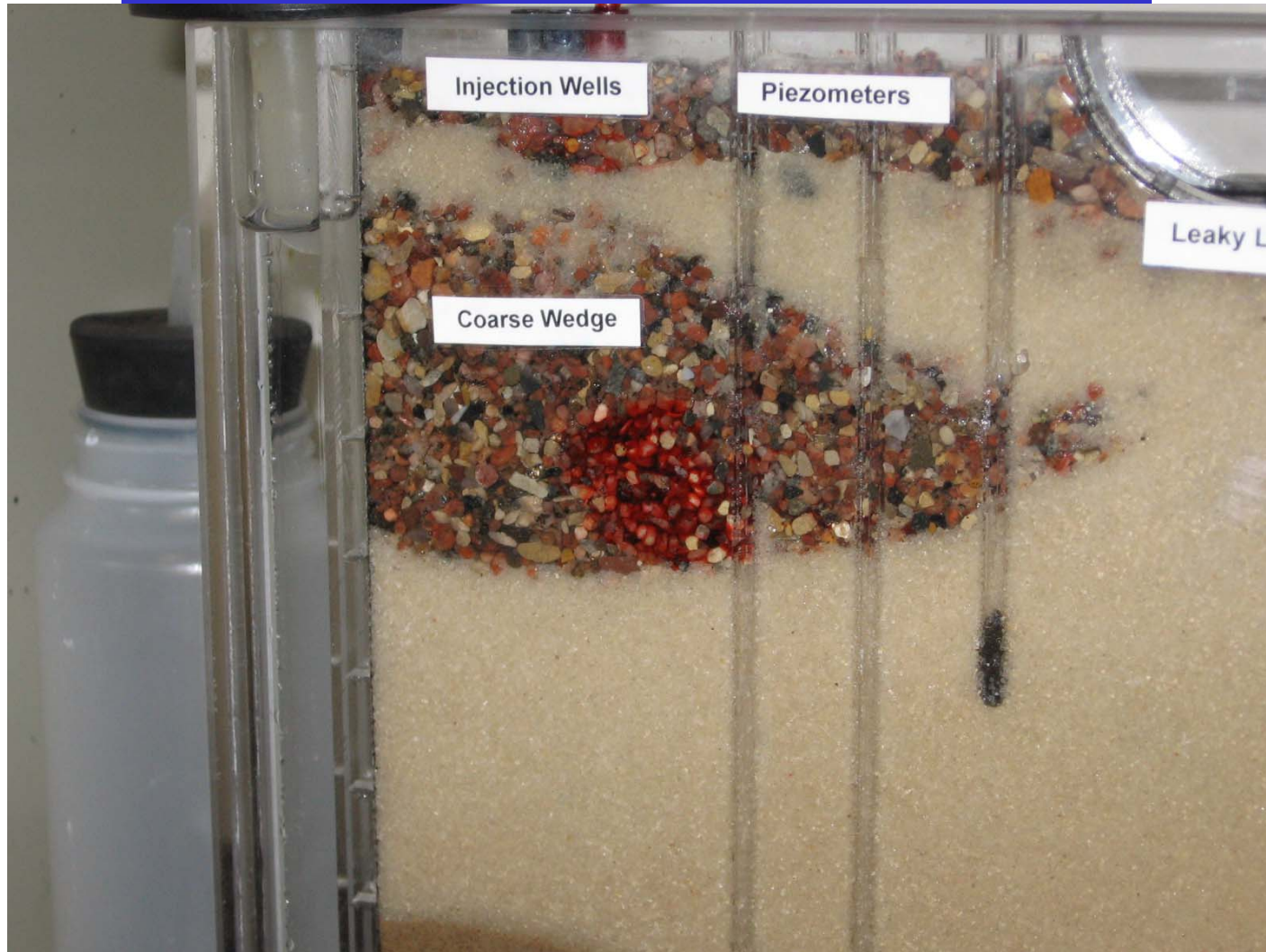
# Contaminant Introduced







# Contaminant Introduced (Cont.)





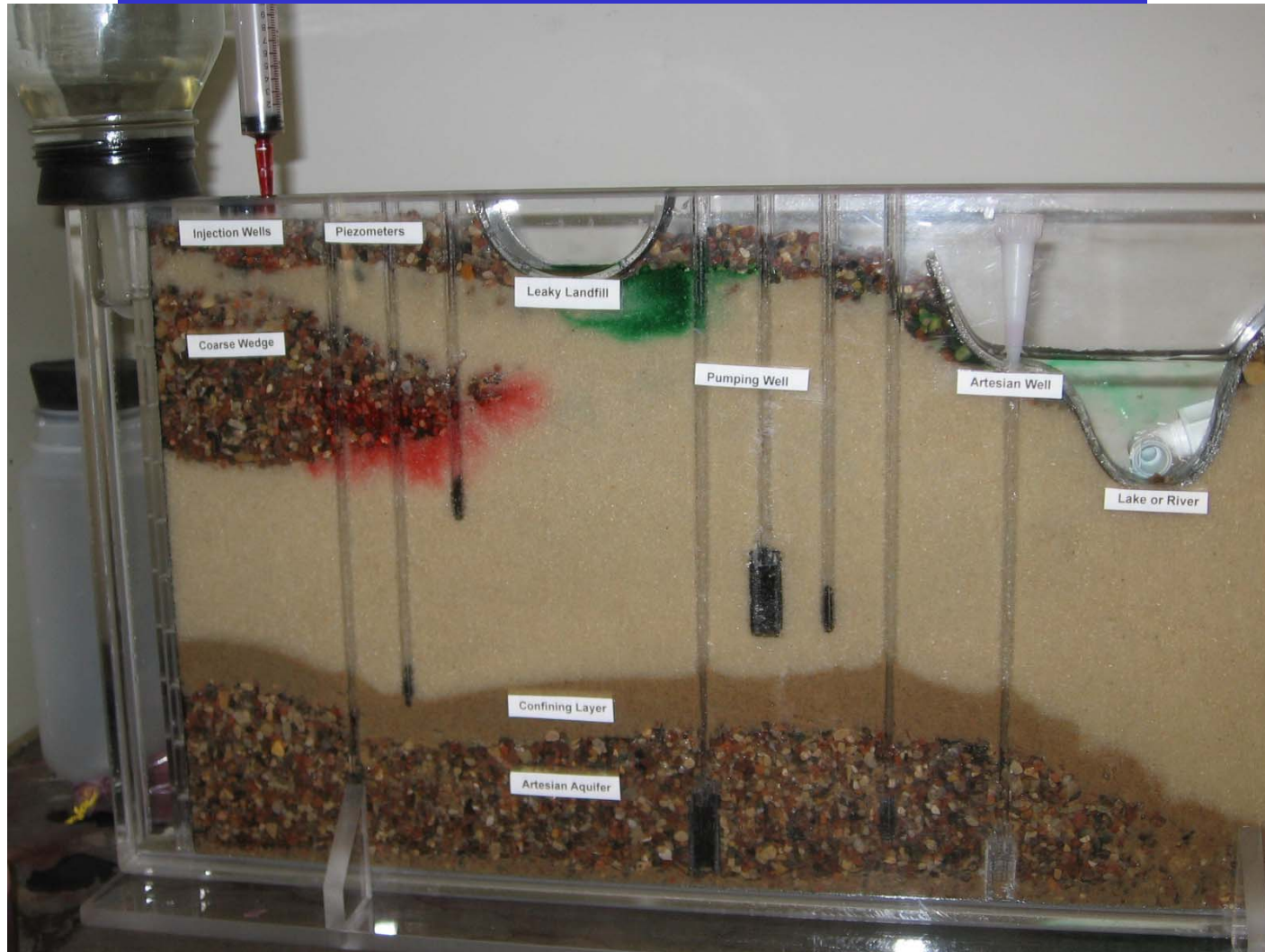
# Contaminant Introduced (Cont.)





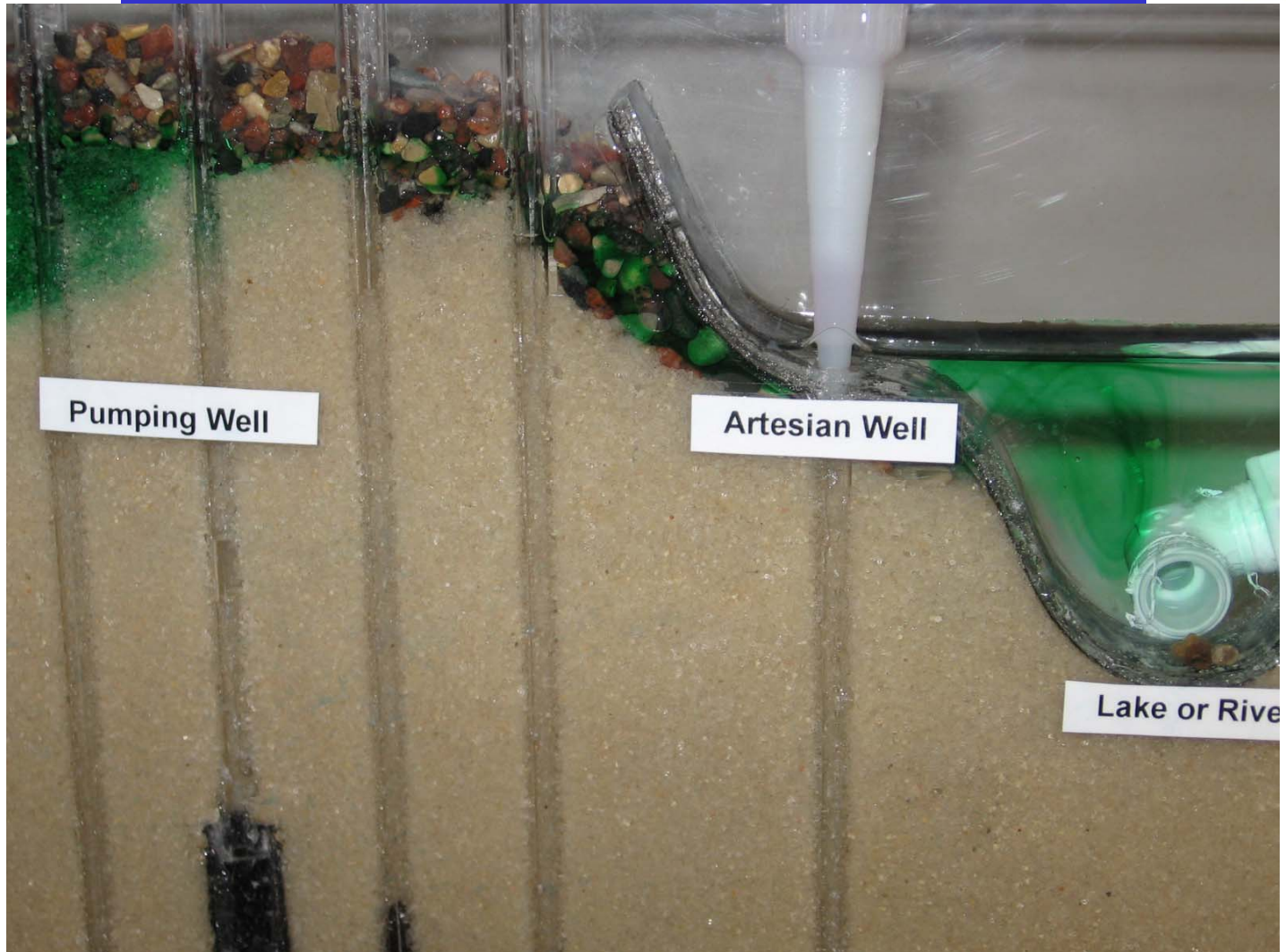


# Advection Begins





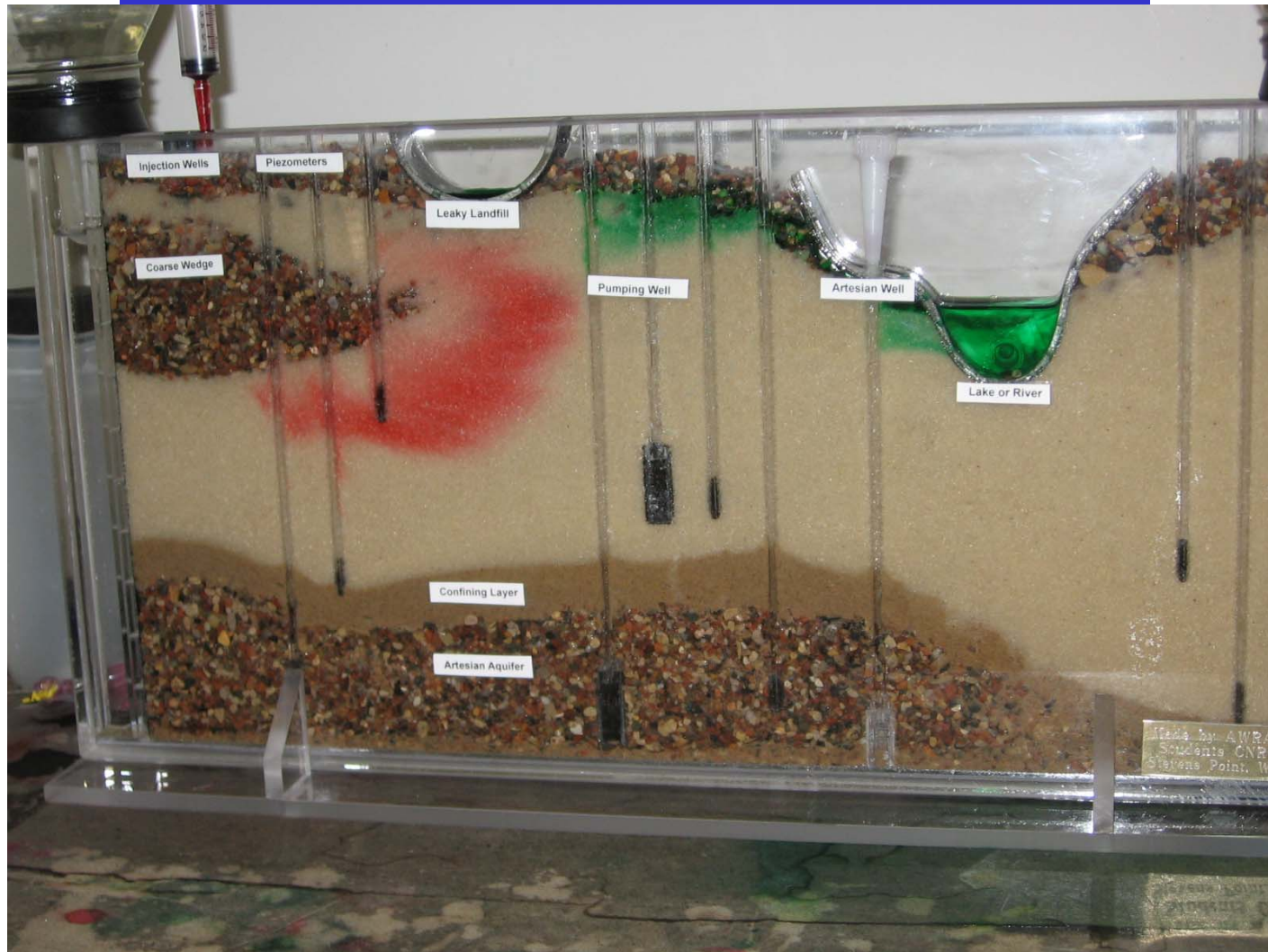
# Advection Continues





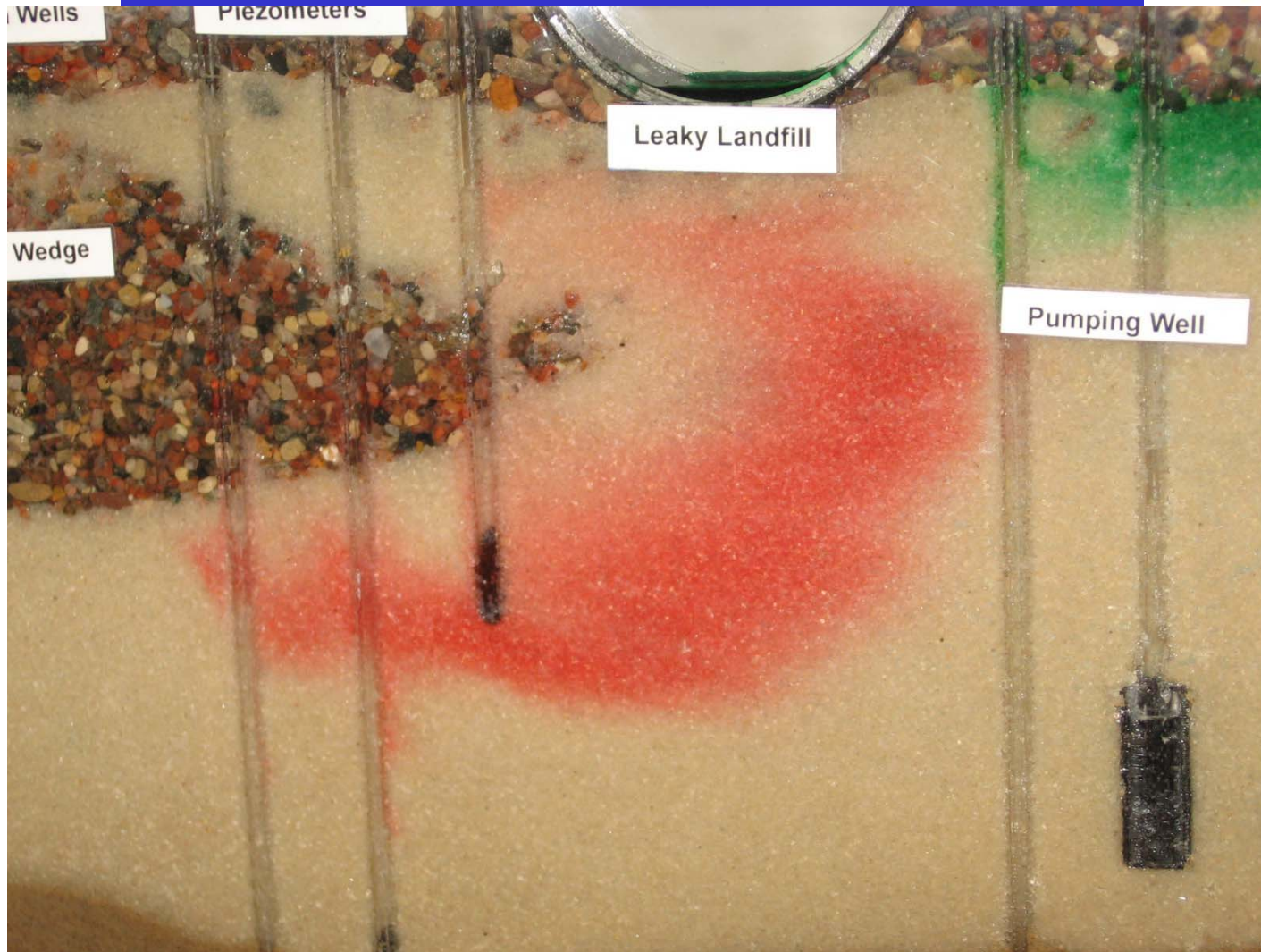


# Dispersion Apparent





# More Dispersion





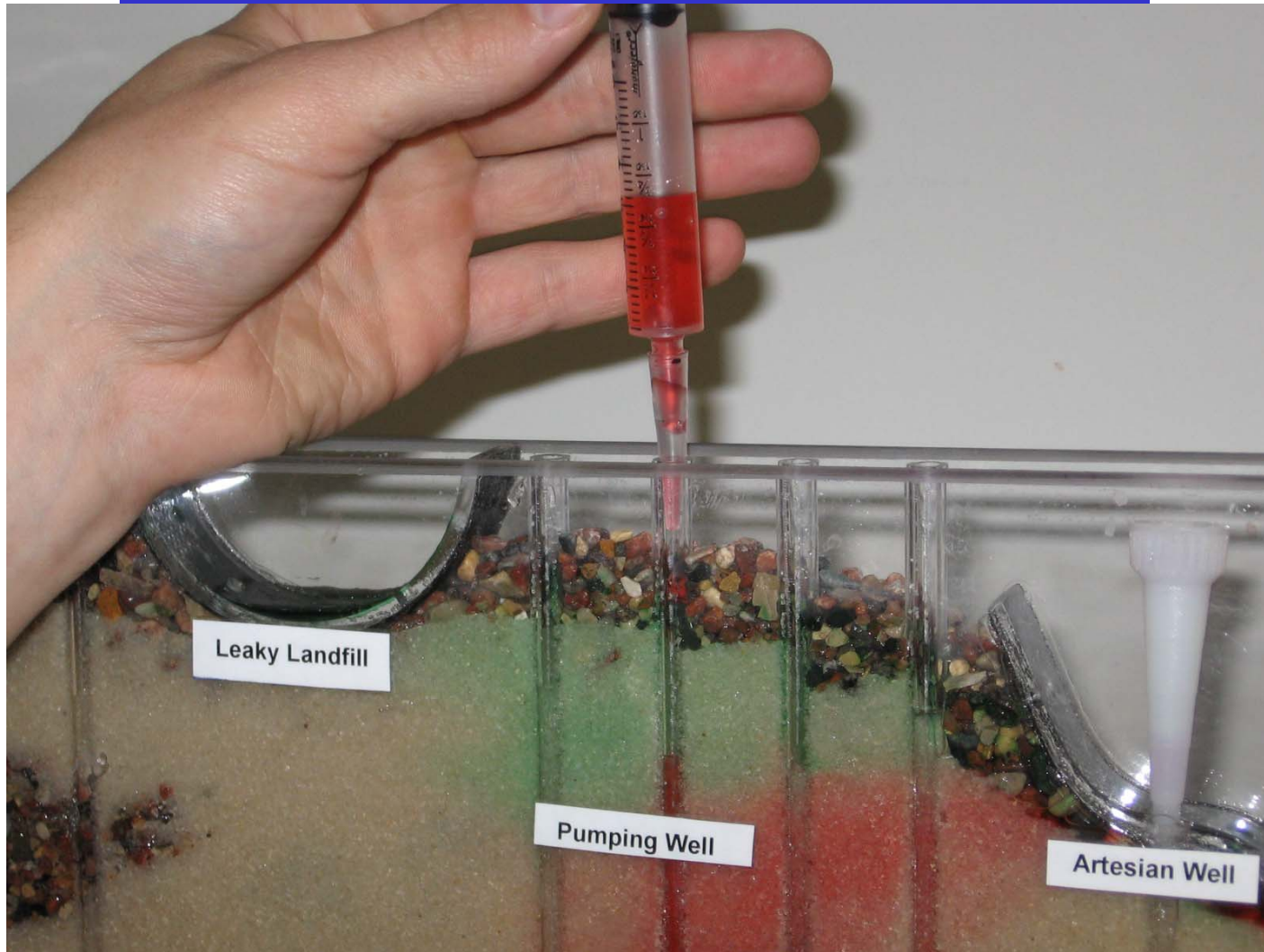


# Groundwater Extraction

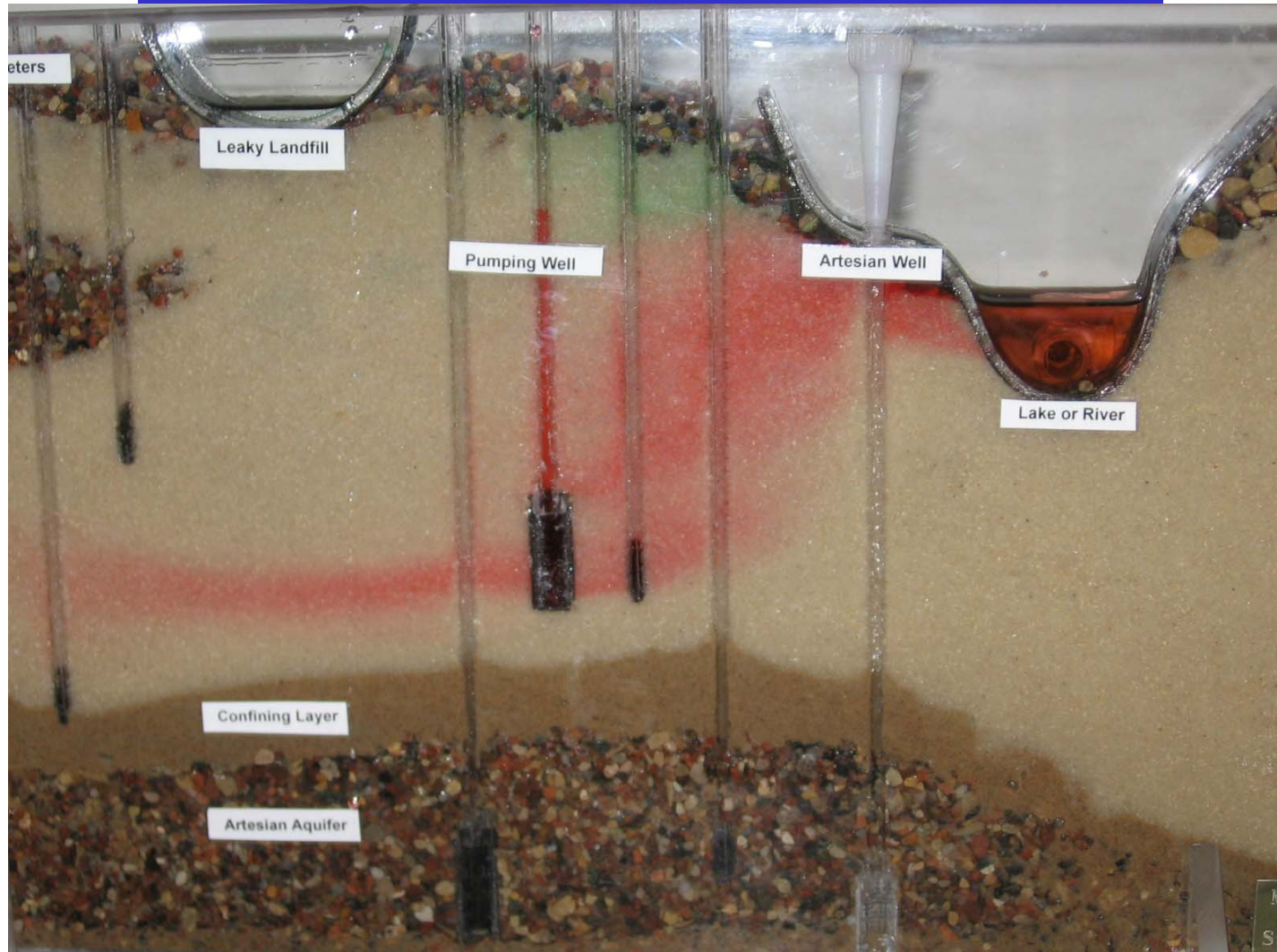




# Groundwater Extraction (Cont.)

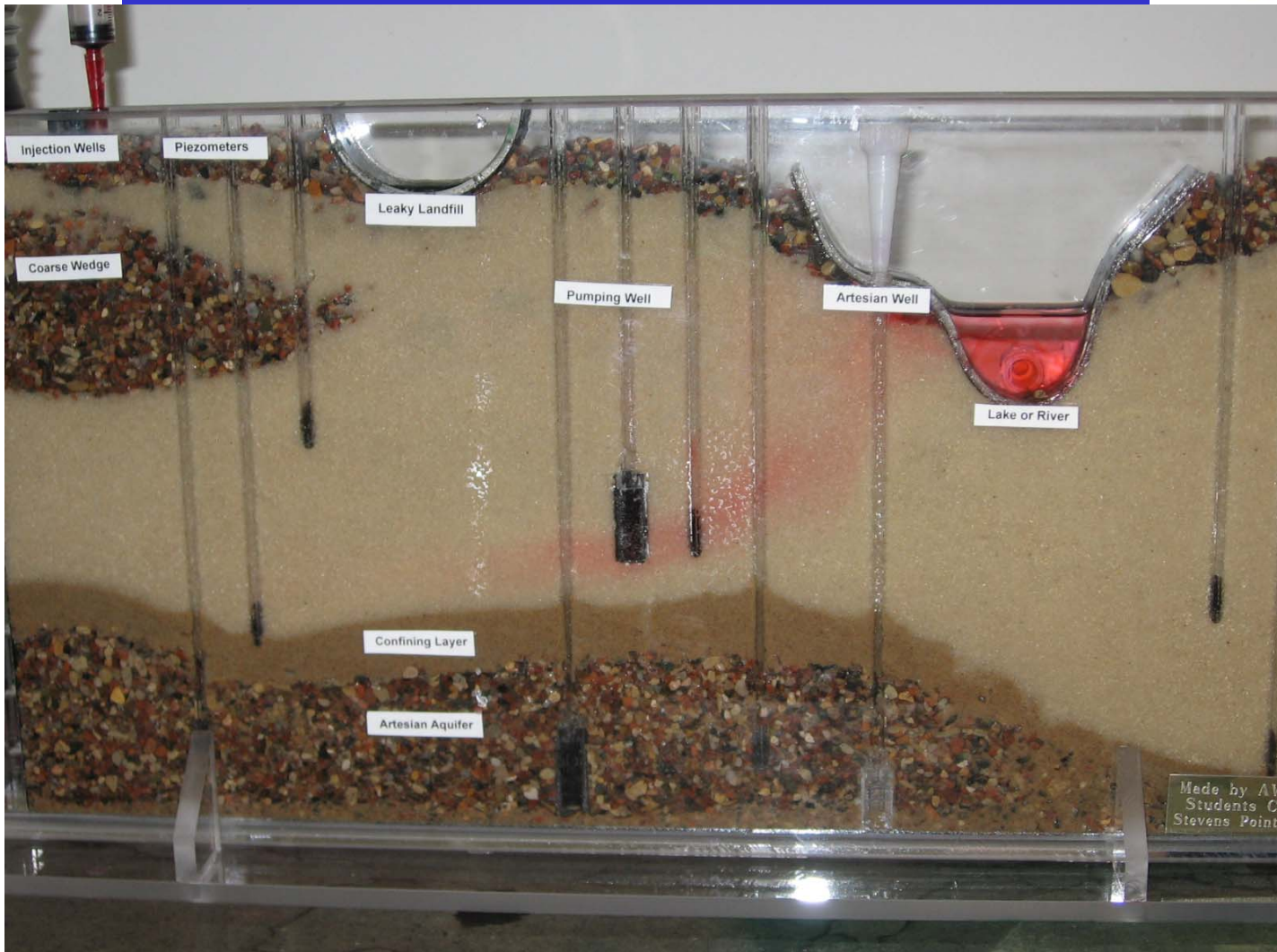








# Much Later ...





# Coming Attractions



- **How contaminants are introduced to the environment**
- **How contaminants move in the environment**
- **Fate of contaminants in the environment**





# Wrap Up



## Questions?

***Thank you for your attention!***